Sound Waves
Coastal Science and Research News from Across the USGS
http://soundwaves.usgs.gov/

Fieldwork

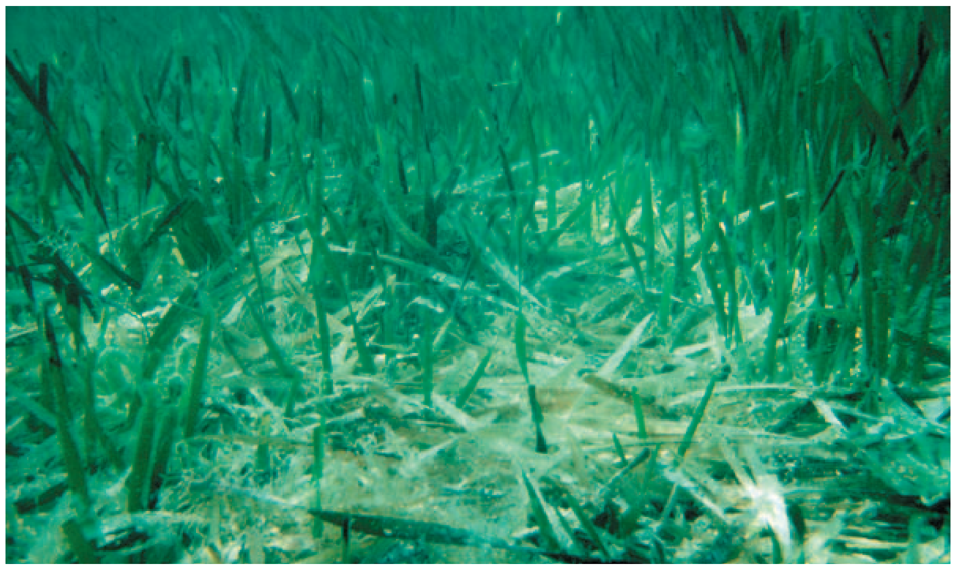
Seagrass Restoration in Tampa Bay

By Christina Kellogg

Seagrasses form one of the world's most productive marine plant communities; some of the most extensive beds occur in Florida's estuaries and nearshore coastal waters (more than 2.5 million acres). The communities provide food and habitat for commercial and sportfishing species, such as spotted sea trout, tarpon, pink shrimp, and spiny lobster, as well as for many types of wading birds and endangered species, such as manatees and sea turtles.

Seagrass meadows, however, are declining worldwide, primarily owing to human-induced disturbances. Declines in seagrass coverage in Florida, particularly in Tampa Bay, have been linked to pollution, worsening water quality, coastal development, loss of tidal marshes, and mechanical damage from dredge filling and scarring by boat propellors. About 35 percent of the seagrass beds have been lost in Florida, where turtlegrass (*Thalassia testudinum*) is the most heavily affected. The greatest impacts occur in such estuaries as Tampa Bay, which has undergone a greater-than-70-percent decrease in seagrass. The slow recovery of turtlegrass after various human impacts, the continued growth of Florida's population, and the subsequent increase in the numbers of shallow-draft boats all suggest that damage to seagrass beds will continue.

Seagrass recovery and restoration, which are a high priority in the Tampa Bay area, are one focus of the U.S. Geological Survey (USGS)'s Gulf of Mexico Integrated Science-Tampa Bay Pilot Study. This project, conducted in collaboration with the University of South Florida (USF), combines experiments in seagrass ecology, biogeochemistry, microbiology, and analysis of chemical contaminants at two sites in the Tampa Bay estuary: Little Cockroach Bay in the Terra Ceia area and



*A turtlegrass (*Thalassia testudium*) bed in Tampa Bay, FL.*

Feather Sound in Old Tampa Bay. Little Cockroach Bay, which is adjacent to an aquatic preserve, has healthy seagrass beds near the test site. Feather Sound has been heavily affected by humans, and very little native seagrass remains.

USF professor **Clinton Dawes** and his graduate student **Mike Meads** have constructed a series of seagrass plots, each containing a single plant. These plots are set up to test whether different types of sediment can improve transplantation. The idea is to experiment with sediment of varying coarseness to see whether keeping the roots of the transplants better oxygenated will allow them to "take" more effectively. The trials are comparing oyster shell, limestone gravel, coarse sand, fine sand, and natural bottom sediment (which varies in texture from plot to plot). Additional plots are being treated with various slow-release fertilizers, to see whether adding nutrients will give the transplants an advantage. The third part of their study

***Clinton Dawes** and students lead the way to the seagrass-transplantation site.*

seeks to determine whether planting the seagrass in degradable containers will improve survival during the critical first 3 to 6 months after transplantation. They are

(Seagrass continued on page 2)

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Contents

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Deadline: The deadline for news items and publication lists for the Dec'02/Jan'03 issue of *Sound Waves* is Friday, December 6.
Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.
Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator© files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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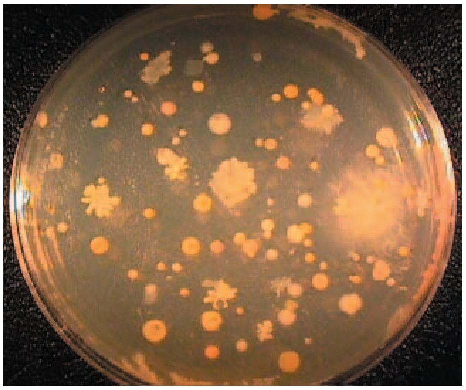
The SHARQ chamber, 16 ft long by 8 ft wide by 4 ft high, is designed to isolate several cubic meters of water and underlying sea floor from the surrounding environment.

(Seagrass continued from page 1)

comparing cardboard, peat pots, pressed-paper pots, and commercial containers.

In coordination with the USF group, several scientists from the USGS Center for Coastal and Watershed Studies in St. Petersburg, FL, have been linking the transplantation study to their integrated science.

- **Kimberly Yates** and her team have mobilized their Submersible Habitat for Analyzing Reef Quality (SHARQ). This underwater "tent" is set up on a native seagrass bed near the transplant plots to gather such data as salinity, pH, dissolved oxygen, fluorescence, and temperature, allowing calculations of metabolism and growth rates for the benthic community.
- **Christina Kellogg** sampled each of the sediment test plots and fertilizer test plots just after they were set up, to count total bacteria and aerobic versus anaerobic viable bacteria. (Viable bacteria are those that will grow on the culture medium, typically just 1 or 2 percent of the total bacteria.) She resampled the same plots later in October, after the plants had completed several growth cycles, to determine whether the treatments have altered the microbial community and whether a correlation exists between healthy plants and any particular microbial group.
- **Mario Fernandez** collected sediment samples from the transplant plots for chemical-contaminant analysis, to test for concentrations of pesticides, such as chlordane or DDT, that might be inhibiting growth of the transplanted seagrass.



A petri dish showing viable aerobic bacteria, grown overnight from a sediment sample collected in the seagrass bed.

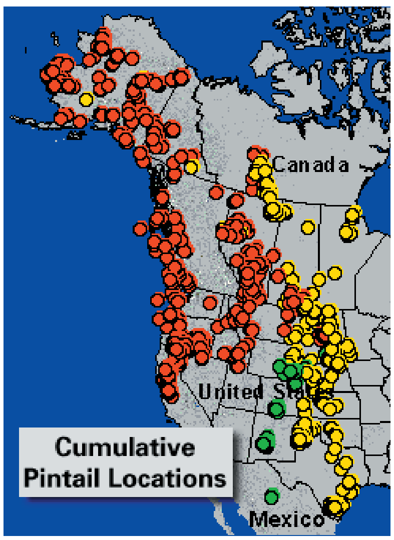
Currently, replanting of damaged turtlegrass beds requires damaging a donor bed to obtain transplants, owing to a lack of nurseries. The development of both nursery stock to supply transplants to damaged areas and techniques to increase growth and survival of damaged beds is needed. Our long-term goal is to formulate procedures for enhancing the growth of turtlegrass and to set up land-based nurseries so that plants will no longer need to be removed from donor beds. A poster describing this research was presented at the Second Gulf of Mexico Integrated Science-Tampa Bay Pilot Study Annual Science Conference (St. Petersburg, FL, Sept. 19, 2002) and will soon be available at URL **http://gulfsci.usgs.gov**. ❁

Scientists Track Pintail-Duck Migration to Learn More About the Species' Population Decline

By Gloria Maender

On September 29, pintail 17530's backpack transmitter beamed a signal from the southwest coast of Alaska to a satellite. She was flying south, nearly 10 months after USGS scientists had equipped her with a platform transmitter terminal (PTT) last winter in California's Central Valley, where nearly half of North America's pintail ducks winter.

Back in Dixon, CA, waterfowl biologists at the U.S. Geological Survey (USGS) have followed pintail 17530's travels on an interactive computer map. Her route appears as a series of red dots linked by directional arrows. One map each documents the migratory route of 30 female pintail ducks that left the valley wearing PTTs in mid-February, northbound for nesting grounds.



Cumulative locations through October 1, 2002, of migrating pintails tagged in late winter 2001 for satellite tracking. Red dots, pintails tagged in California; green dots, pintails tagged in New Mexico; yellow dots, pintails tagged in Texas. The red dots approximately delineate the Pacific flyway; the green and yellow dots, the central flyway. Updates and additional maps of pintail locations can be viewed on the World Wide Web at URL ***http://www.werc.usgs.gov/pinsat/***.

"The pintails we have tracked over the past 3 years by satellite migrate many hundreds of miles along the Pacific flyway to nesting destinations ranging from the prairies of southern Alberta and Saskatchewan to Alaska, and even Russia," said wildlife biologist **Michael Miller** of the USGS' Western Ecological Research Center.

An international team of waterfowl biologists and technicians from the USGS, Ducks Unlimited, Inc. (DU), DU Canada, and the California Waterfowl Association (CWA), funded primarily by the Tuscany Research Institute of Las Vegas, NV, is using satellite telemetry to determine the migration routes and identify the major resting areas of these birds. **Miller** leads this research effort, assisted by **Joe Fleskes** and several other USGS biologists and geographic-information-system (GIS) technicians in the everyday running of the study. By piecing together what they learn from this study with additional data from studies using standard radio telemetry, the scientists hope to determine whether unknown factors are affecting this species' decline.

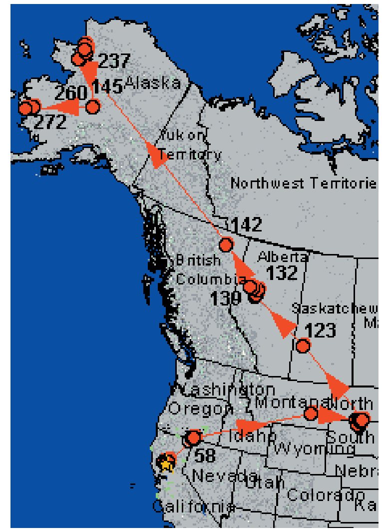
"Persistent drought, large populations of alien predators, and conversion of native prairie to farming in critical nesting regions of southern Canada and the northern Great Plains in the United States have resulted in repeated pintail nest failures over many decades," said **Fleskes**.

As recently as the 1970s, the U.S. Fish and Wildlife Service estimated a North American breeding population of 5 to 7 million pintails in principal nesting areas. By 1991 and again in 2002, however, the pintail breeding population dipped to an all-time low of 1.8 million.

One of the most widely distributed ducks in the world, the northern pintail (*Anas acuta*) is a medium-size duck with slender, elegant body lines. Pintails are "dabbling ducks" and forage on grains, marsh-plant seeds, and aquatic invertebrates throughout the fall and winter.

"During the non-nesting seasons, pintails must replenish their body reserves to be able to survive winter, migrate north again the following spring, and produce young," said **Fleskes**.

Until the 1980s, said **Fleskes**, midwinter populations of pintails in California's Central Valley reflected the overall popula-



Migration route of pintail 17530. Star in California's northern Central Valley shows where she was tagged with a satellite transmitter. Dots show Julian dates (number of days elapsed since Jan. 1, 2002) on which the bird was present. Julian date 272, for example, corresponds to September 29.

tion trend. Since then, however, declines have been greater in the southern regions of the Central Valley (San Joaquin Valley) than in northern areas (Sacramento Valley). To understand this disproportionate decline, **Fleskes** has worked with **Dave Gilmer**, also a USGS research biologist, and **Robert Jarvis**, from Oregon State University, to fit standard radio transmitters to the backs of 419 young and adult female pintails and follow them for three consecutive winters.

The three scientists found that neither contaminants nor disease, but a redistribution accounted for the disproportionate declines in wintering pintails in the southern Central Valley.

"More than 80 percent of the tagged pintails shifted each midwinter from areas in the south having less abundant habitat for food and refuge, to locales in the Sacramento Valley more favorable for their survival," said **Fleskes**.

The change each winter in pintail distribution appears to be related to loss of suitable habitat, drought conditions, and

(Pintail Ducks continued on page 4)

(Pintail Ducks continued from page 3)

*Pintail duck fitted with a standard radio transmitter. Photograph courtesy of **Gary Zahm**, U.S. Fish and Wildlife Service.*

the lesser-quality habitat of cotton-farmed lands in the San Joaquin Valley, which lack winter flooding, in contrast to the flooded ricelands of the Sacramento Valley, said **Fleskes**.

Spring migration to nesting regions begins as early as February and is well underway by March. Pintails begin to arrive in prairie nesting areas at the end of March or early April. By May, females will be incubating their eggs in nests they have built on the ground of short grasses and brush. They lead their 8 to 12 ducklings, which hatch together in one day, to water. There the ducklings feed on mostly aquatic invertebrates till fledging by July or August.

For the spring 2003 migration, the team of scientists will outfit 30 adult female pintails with PTTs in the Sacramento Valley. As they did last winter, the team will tag an additional 10 birds in central New Mexico and 20 in Texas, to add birds to the study that winter in the central flyway. After trapping crews release the birds, **Miller** will receive satellite data on each bird's movements every 3 days through the following August, or until the PTTs quit.

"The first stop or staging area for more than 75 percent of the pintails is northeastern California and southern Oregon, where they build body reserves for their remaining migration," said **Miller**. "They remain there for as little as a few days up to two months, depending on the migration routes ultimately used."

The team pinpoints specific habitats the ducks use at this staging area by fitting additional ducks with standard radio transmitters and following them from the ground. Obtaining day and night locations for each duck in spring 2002, the researchers determined specific habitat use for more than 80 percent of 150 radio-tagged pintails.

"The satellite and standard radio data have revealed key staging areas in northern California and southern Oregon," said **Fritz Reid**, DU's director of conservation planning for the western United States. "Organizations such as Ducks Unlimited and the U.S. Fish and Wildlife Service can now focus protection and restoration efforts on these areas with the aid of private landowners and state agencies. The pintail satellite data have further provided insight into critical areas of the prairies and western boreal forest that warrant protection," **Reid** added.

Upon leaving southern Oregon and northeastern California, about 40 percent of the pintails fly directly to southern Canada, followed by an additional 25 percent that use one or more additional resting areas along the way, said **Miller.** Another 25 percent head for Alaska, traveling along the coast or directly over the Pacific Ocean, a trip of more than 2,000 miles. The remaining 10 percent fly to the Dakotas.

Miller directed field technicians to nearly 100 stopover areas to document habitat use and behavior of pintails during the first 2 years of the project. "Pintails observed near the tagged hens used a variety of habitats, ranging from stock ponds to tundra," said **Miller**, "with greater use of private than public lands."

One of the principal pintail nesting regions is the Prairie Pothole Region in North and South Dakota, northeastern Montana, and the southern prairie provinces of Canada. "Prairie drought has prevailed each year of the study period, and most of the satellite-tracked pintails flew on to areas farther north," said **Miller**. The birds migrating directly to Alaska, however, another critical nesting region, were not affected by prairie drought.

Above-average rainfall in southern Alberta and southern Saskatchewan this summer after the pintails' passage gives **Miller** and the team cause to believe they may find pintails nesting there next spring.

"If the wetlands are replenished and uplands have enough cover to attract pintail females next March and April, we can expect a high proportion of tagged pintails to stop in the prairie region, rather than continue on farther north."

To learn more, please visit the Web site "Discovery for Recovery" at URL **http://www.werc.usgs.gov/pinsat/**.

*Truck with antennae used for tracking ducks tagged with standard radio transmitters. Mountains in background are the Sutter Buttes in California's Sacramento Valley, after a rare snowfall. Photograph by **Michael Miller**, USGS.*

Remote Sensing of Coral Reefs: Testing the Waters at Biscayne National Park

By Tonya Clayton

Biscayne National Park. Panoramic image courtesy of USGS SOFIA Virtual Tour at URL ***http://sofia.usgs.gov/virtual_tour/pgbiscaynebay.html****.*

South of Miami on Florida's Atlantic coast, at the north end of the Florida coral-reef tract, lies Biscayne National Park. It is 95 percent submerged, with 700 km^2 of mangrove forest, shallow estuarine waters, uninhabited keys, and popular coral reefs. The reef tract is famous as a classic field area for studies of Pleistocene and Holocene carbonates, and the park itself was the site of some of the earliest studies in airborne remote sensing.

One current research project in the park seeks to further develop remote-sensing methods appropriate for shallow-bottom areas. In August 2002, scientists from several institutions gathered at Biscayne National Park for 10 days of cooperative fieldwork organized by U.S. Geological Survey (USGS) scientists **John Brock** and **Tonya Clayton**. This fieldwork was part of an ongoing collaboration with **Wayne Wright** of the National Aeronautics and Space Administration (NASA), in support of the development and evaluation of a new airborne sensor designed with coral-reef environments in mind. Thanks to **Richard Curry**, Biscayne National Park's science coordinator, the park has served as a primary study site for this and several other USGS science projects. (See, for example, previous *Sound Waves* articles: "Ground-Truthing Coral-Reef Maps Produced from Remote-Sensing Data," May 2002; "Core Drilling in Biscayne National Park," July 2001; and "USGS Collaborates with Biscayne National Park on Coral-Reef Research," August 2000.)

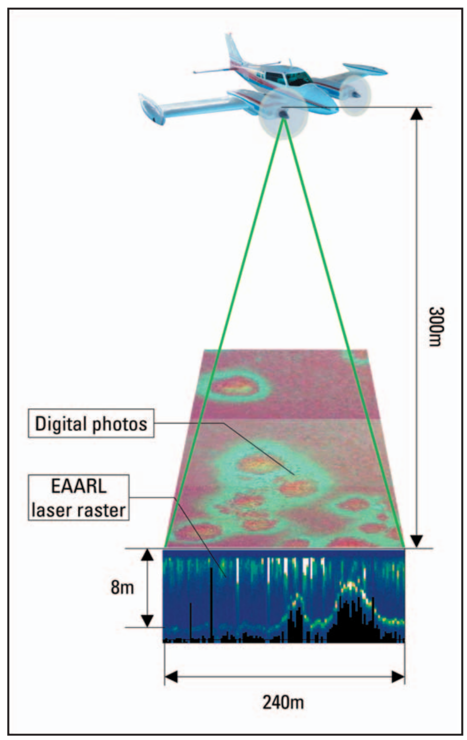
The purpose of this particular mission was to collect new kinds of lidar (light detection and ranging) and photographic data from an aircraft, while boatborne collaborators simultaneously collected "sea-truthing" acoustic and optical data over selected reef areas. (Airborne lidar uses laser light to efficiently and accurately measure the elevations of features on land and in shallow water.)

At center stage was the NASA Experimental Advanced Airborne Research Lidar (EAARL), developed by **Wayne** and flown on a Cessna 310 by pilot **Virgil Rabine** and copilot **Wayne**. (See "NASA EAARL Lidar Test at Wallops Flight Facility," *Sound Waves*, April 2001).

On the ground, **Amar Nayegandhi** (USGS) and NASA interns **Conan Noronha** (NASA/University of Southern California) and **Enils Bashi** (NASA/Salisbury University) provided real-time programming and aircraft-data processing. NASA intern **Kevin Riordan** (NASA/University of South Carolina) collected terrestrial ground-truthing data, while USGS intern **Lance Mosher** (USGS/Eckerd College) manned a global-positioning-system (GPS) base station at Adams Key.

The crew of the "optics boat" included **Tonya**, **John**, **Don Hickey** (all of the USGS), and **Emmanuel Boss** (University of Maine). One primary function of this platform was the deployment of a small multisensor package assembled to measure several water-column optical properties, such as absorption and attenuation of light, and various indexes of light scattering. At selected sites, detailed characterizations of the sea floor were made, along with measurements of light upwelling from the sea floor and the water column. While towing the optics package on horizontal transects, the boat also towed a video camera to take pictures of the seagrasses, corals, and sand on the bottom. **Zhiqiang Chen** (University of South Florida) spent some time on the boat and, in addition, processed water samples for chlorophyll concentration and for light absorption by various water-column constituents.

(Biscayne National Park continued on page 6)



The NASA Experimental Advanced Airborne Research Lidar (EAARL) collected georectified digital aerial photographs concurrent with high-resolution lidar views of water-column properties and underwater topography. Here, shallow patch reefs are visible in both the photomosaic and the lidar raster image (cross section).

(Biscayne National Park continued from page 5)

The National Coral Reef Institute (NCRI) provided the "acoustics boat." The crew here included **Bernhard Riegl** (NCRI), **BJ Reynolds** (USGS), **Ryan Moyer** (NCRI), and **Brian Walker** (NCRI). Sonar data collected at 50- and 200-kHz frequencies are being used to map bathymetry and bottom type. Coincident towed video footage was collected in selected areas. **BJ** pulled double duty by also coordinating the field GPS measurements.

One highlight of the trip was a field trip from the field trip: after several long(!) days in the searing subtropical sun, everyone took a day off from the open waters (and skies) and met at the Marathon airport to visit the aircraft and view the EAARL operations. USGS botanist **Tom Smith**, who happened to be working in Everglades National Park at the time, also joined the excursion, which was a welcome and well-earned opportunity to share some shade, data, and veggieburgers.

***Emmanuel Boss** monitors the descent of the optics package. The orange floats are mounted atop the package frame to achieve near-neutral buoyancy and a controlled, slow descent of the sensors through the water column. Coral-reef substrate is visible through the clear waters.*

During the final few days of the field trip, colleagues from Florida Atlantic University joined in. The star of this show was the *Morpheus*, a modular autonomous underwater vehicle (AUV) designed to collect video and sidescan-sonar data. **Edgar An**, assisted by **Rob Coulson**, **Joe Lambiotte**, **Gabriel Grennon**, **Abby Chronister**, and **Capt. Bob Franks**, deployed the *Morpheus* on two missions: the first over Anniversary Reef, a shallow reef that serves as one focus area of the larger USGS project; and the second, under **Richard's** guidance, over deeper reef areas. The AUV provided a rare opportunity to obtain a close-up look at depths inaccessible to divers.

***Rob Coulson** accompanies the* Morpheus *(circled) on its Anniversary Reef mission. (This was our best weather day ever!) Image courtesy of **Joe Lambiotte**, Florida Atlantic University.*

This trip was made possible by the generous support of many folks both in the field and in the lab. In addition to the participation noted above, **Richard** provided a park boat that was ideal for deploying the optics package, as well as dive tanks and air arrangements that greatly facilitated data collection. **Shay Viehman** (Biscayne National Park) also assisted with the many logistic arrangements and details. **Pam Reid** and **Art Gleason** (University of Miami) generously provided laboratory space and many liters of optically clean water (a rare commodity!) for essential instrument calibrations. **Charlie Mazel** (Physical Sciences, Inc.) and **Chuanmin Hu** (University of South Florida) facilitated reflectance measurements. The contributions of these folks and all others who pitched in to make the trip a success are gratefully acknowledged. ☸

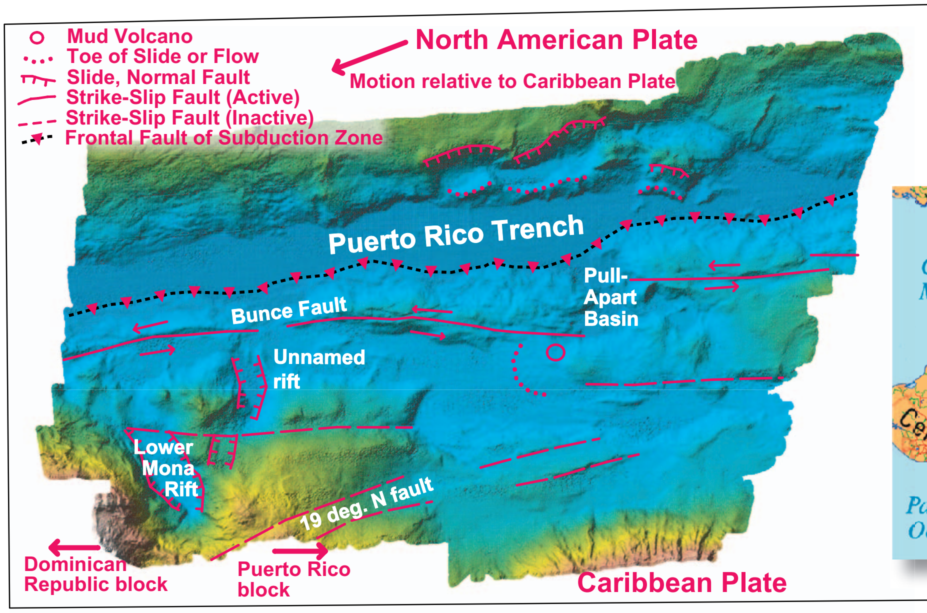
USGS, University of New Hampshire, and NOAA Cooperate in Exploring the Puerto Rico Trench

By Uri ten Brink

The Puerto Rico Trench, with water depths exceeding 8,400 m, is the deepest place in the Atlantic Ocean, comparable to the deep trenches in the Pacific Ocean. The Pacific trenches occur where one tectonic plate subducts, or slides, under another one. The Puerto Rico Trench, in contrast, is situated at a boundary between two plates that slide past each other with only a small component of subduction. The trench is shallower where the component of subduction is larger. The unusually deep sea floor is not limited to the trench but also extends farther south toward Puerto Rico. The Puerto Rico Trench is also associated with the most negative gravity anomaly on Earth, -380 milliGals, indicat-

(Puerto Rico Trench continued on page 7)

(Puerto Rico Trench continued from page 6)



Sea-floor area mapped during the September 2002 cruise, showing location of the Puerto Rico Trench.

ing the presence of an active downward force. Finally, a carbonate platform, which was originally deposited in flat layers near sea level, is now tilted northward at a uniform angle. Its north edge is at 4,500-m depth, and its south edge is observable on land in Puerto Rico at an elevation of a few hundred meters. Several tectonic models have been proposed to explain these unusual observations, and marine exploration efforts of the type reported here are needed to discriminate between them.

Many earthquakes and tsunamis resulting from these plate-tectonic movements have occurred during historical time in the northeastern Caribbean. As the population in this region continues to grow, future events will pose serious hazards to the 4 million U.S. citizens of Puerto Rico and the Virgin Islands, mainly in the form of submarine faults and landslides.

U.S. Geological Survey (USGS) scientists recently participated in a short exploration cruise to map part of the Puerto Rico Trench. The cruise resulted in the discovery of a major active strike-slip fault system close to the trench, submarine slides on the descending North American tectonic plate, and an extinct mud volcano, which was cut by the strike-slip fault system. Another strike-slip fault system closer to Puerto Rico that was previously considered to accommodate much of the relative plate motion appears to be inactive. The seaward continuation of the Mona Rift, a zone of extension between Puerto Rico and the Dominican Republic that generated a devastating tsunami in 1918, was mapped for the first time. These discoveries indicate weak coupling between the descending North American plate and the overlying Puerto Rico block, leading us to suggest that this part of the plate boundary may be capable of generating only moderate earthquakes. An additional 3-week cruise is planned for February 2003 to map the remaining part of the Puerto Rico Trench and provide a base map for further tectonic, environmental, and biological studies.

The cruise, funded by the National Oceanic and Atmospheric Administration (NOAA)'s Office of Ocean Exploration, was carried out September 24-30, 2002, aboard the NOAA ship *Ronald H. Brown*. Multibeam bathymetry and acoustic-backscatter data were collected over an area of about 25,000 km^2, bigger than the State of

(Puerto Rico Trench continued on page 8)

***Chuck Worley** processing multibeam data aboard the NOAA ship* Ronald H. Brown.

(Puerto Rico Trench continued from page 7)

New Jersey. Participants included **Uri ten Brink** (chief scientist) and **Chuck Worley** from the USGS Woods Hole Field Center, and **Lt. Shep Smith**, NOAA, from the Center for Coastal and Ocean Mapping Joint Hydrographic Center, a University of New Hampshire program operating in partnership with NOAA's National Ocean Service. ☸

The fort in old San Juan, Puerto Rico, with the NOAA ship Ronald H. Brown *on the horizon. Photograph taken by* ***Lt. Mike Hoshlyk****, NOAA, on our way to board the ship.*

Research

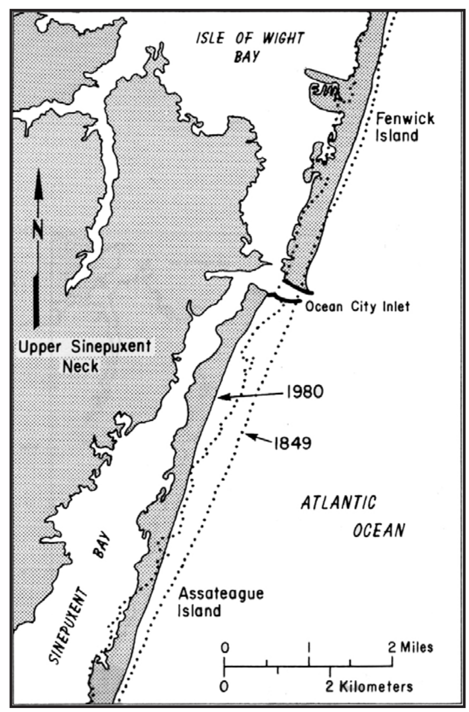
USGS Research Contributes to Assateague Island Restoration—Mitigating 70 Years of Coastal Erosion Due to Ocean City Inlet Jetties

By Jeff Williams

Coastal erosion, a serious and widespread societal issue affecting all the coastal regions of the United States, results from complex geologic and oceanographic processes, such as storms, changes in sediment supply at the coast, and sea-level rise. During the past century, however, manmade alterations in the coastal zone have become increasingly responsible for a share of the erosion. All of this erosion is taking place at the same time as explosive population growth and development along all coasts.

Ocean City inlet, MD, is one of the most striking examples of the unintended consequences of engineered inlets causing increased erosion of adjacent barrier islands downdrift from the jettied inlet. The Ocean City inlet opened during a 1933 hurricane, and soon after, the twin stone jetties were built by the U.S. Army Corps of Engineers (USACE) to maintain the inlet for navigation. However, the jetties also severely disrupted littoral-inlet processes, trapped sand on the north side of Fenwick Island (site of the Ocean City amusement park and parking lot), and severely starved Assateague Island National Seashore to the south of sand. The result of almost 70 years of disrupted sand transport along the coast has been an offset in the two barrier islands—Fenwick and Assateague—by approximately 1 km, along with accelerated erosion, reduction and alteration in beach-berm heights, and loss of critical beach and dune habitats. The effects attributable to the jetties have extended about 15 km southward from the inlet.

To mitigate the effects of Ocean City inlet, a bold plan of coastal restoration began in August 2002, with a price tag of $63 million. The restoration is a partnership between the National Park Service (NPS), the USACE, and the Minerals Management Service (MMS). The plan to restore Assateague consists of an initial, short-term phase in which 1.8 million cubic yards of sand dredged from Great Gull Bank, a linear shoal on the shelf, will be added to Assateague Island beaches. A longer-term phase will follow over the next 25 years, in which sand will be mechanically dredged and bypassed from the Ocean City inlet area and placed on Assateague Island beaches on spring and fall schedules, in a phased approach intended to replicate natural processes. This plan of restoration could become a model for other coastal regions where engineering structures have disrupted littoral processes, causing increased erosion and land loss.



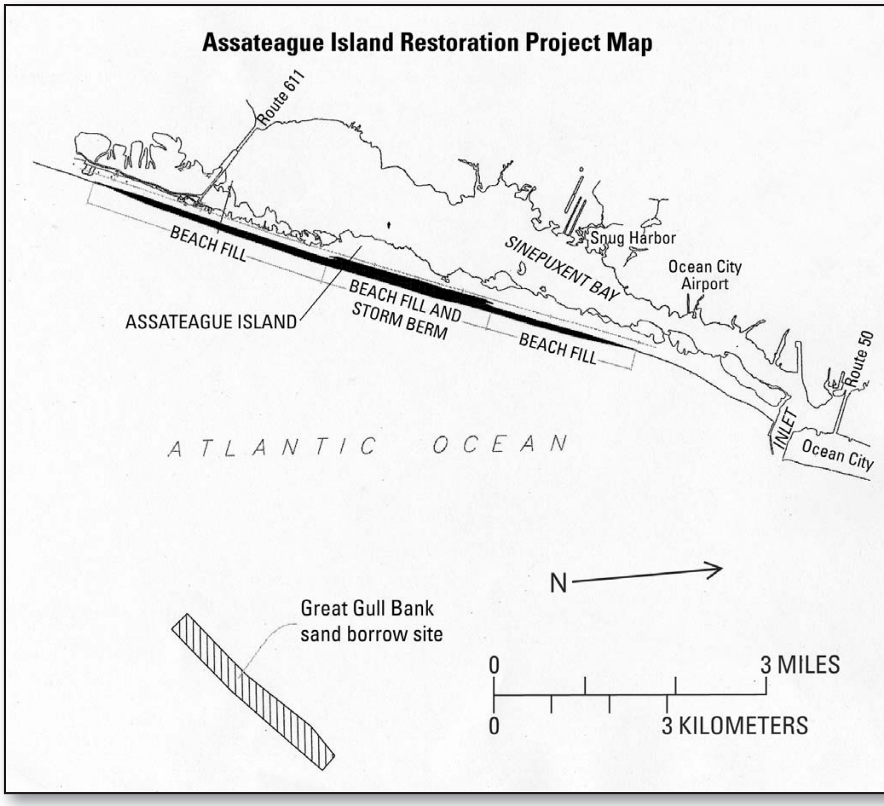
Changes in the shorelines of Fenwick Island and Assateague Island between 1849 and 1980 illustrate the effects of the two large jetties at Ocean City inlet on coastal sediment transport along the adjacent coast.

Science has been instrumental in understanding the connection between inlet processes and erosion of Assateague

(Assateague Island continued on page 9)

(Assateague Island continued from page 8)

Island and in designing the restoration plans. The USGS' role, in cooperation with the Maryland Geological Survey and the NPS, has been to (1) map the geology and sedimentology of the sea floor and subsea floor; (2) identify potential sand-borrow sites, including linear shoals, such as Great Gull Bank; (3) map historical shoreline change, including recent use of lidar (light detection and ranging) technology (an airborne system that uses laser light to measure elevation); and, most recently, (4) use Assateague Island, as one of a dozen sites nationwide, to evaluate the risk and vulnerability of coastal regions to future sea-level rise.



Assateague Island. Sand dredged from Great Gull Bank will be added to Assateague Island beaches (shaded black) to mitigate the erosion effects of the Ocean City inlet jetties.

Outreach

Dedication of a New Vessel for Research on Lake Mead

By Dave Twichell

Dave Twichell, a U.S. Geological Survey (USGS) geologist from the Woods Hole Field Center on sabbatical to the University of Nevada, Las Vegas (UNLV), participated in the dedication of a new vessel to be used for education and research on Lake Mead. One of the world's largest manmade reservoirs, Lake Mead lies behind Hoover Dam on the Colorado River east of Las Vegas. The lake is the site of several years of ongoing sediment studies by **Dave** and his collaborators.

In addition to the new vessel, named *Forever Earth*, a coring barge operated by UNLV and the National Park Service was on display at the dedication. **Dave** and **Mark Rudin** from UNLV were asked to explain the coring operations and show some of the cores to about 40 students, the press, and dignitaries as they toured the coring barge. The students were part of a middle-school chorus that sang at the dedication before touring the boats. Many of the students enthusiastically participated in the "hands-on" experience of touching the cores.

In addition to **Dave**, **Ken Covay** and **Dan Bright** of the USGS' Water Resources Discipline (WRD) were present to represent the USGS. **Dan** started his USGS career in the Coastal and Marine Geology team's geotechnical lab in Menlo Park, CA, and now works as a hydrologist in the WRD office in Las Vegas.

***Dave Twichell** describing the geologic story of Lake Mead, as preserved in a vibracore, to middle-school students from the Las Vegas area.*

Sea-Level Change—a Workshop to Define Science Needs and Future USGS Research Directions

By Jeff Williams and Rob Thieler

A workshop on sea-level change was convened by the U.S. Geological Survey (USGS) at Woods Hole, MA, on September 24 and 25, 2002. The meeting focused on three main topics:

- the current state of understanding of sea-level change over recent geologic time, with emphasis on the past 20,000 years;
- the effects of sea-level change on rates of coastal erosion, accretion, and sediment movement; and
- potential future directions for USGS-supported research on sea-level change.

Twenty-five research scientists from the USGS (Woods Hole, MA; St Petersburg, FL; Menlo Park, CA; Santa Cruz, CA; Lafayette, LA; Patuxent, MD; Reston, VA), the University of Hawaii, the University of Toledo, the Woods Hole Oceanographic Institution, and Boston University attended. Their talks and lively discussions clarified some important points about sea-level

(Sea-Level Change continued on page 11)

The Need for Better Scientific Understanding of Sea-Level Change

By Jeff Williams and Rob Thieler

Coastal regions are dynamic, yet sensitive, environments composed of complex geologic features that are influenced by a mix of physical and biological processes operating across a wide range of spatial and temporal scales. Understanding these processes is crucial because all the States bordering the oceans and the Great Lakes, as well as the United States' Caribbean and Pacific island territories, are undergoing widespread, long-term, and increasingly severe coastal erosion and property damage due to various complex geologic processes.

In 2000, the H. John Heinz III Center for Science, Economics and the Environment, a nonprofit institution in Washington, DC, reported that an explosive population shift and associated increase in development in coastal zones during the past 50 years has resulted in greatly increased risk to 160 million Americans and more than $3 trillion in coastal development. Continuing urbanization of the coastal zone in a time of rising sea level increases the risks from such hazards as major storms. Loss of wetlands, coral-reef ecosystems, and sandy beaches due to manmade alterations; saltwater intrusion into coastal ground-water aquifers; and acceleration of global sea-level rise are also predicted to increase significantly during the 21st century. These coastal hazards and the issues confronting the United States are common to most other coastal regions of the world as well. A compelling need therefore exists for coastal scientists to be able to reliably predict coastal change on spatial and temporal scales and with confidence limits that are meaningful to society in planning for the next 50 to 100 years.

Coastal environments owe their dynamic nature to physical processes, such as storm waves and currents and winds, that act on the widely varying geologic landforms composing coasts. Biological processes affect sediment behavior and modify the influence of geologic processes on wetlands and estuaries. Sea level relative to the land surface is controlled by several interacting processes: isostatic and tectonic crustal movements, thermal expansion and contraction of the oceans, grounded-ice-sheet volumes, and short-term ocean-atmosphere interactions, such as the El Niño-Southern Oscillation (ENSO) in the Pacific Basin and the North Atlantic Oscillation (NAO) in the Atlantic Basin. Although sea-level change has little capacity to actually erode and transport sediment, sea-level rise can be a major factor in effecting coastal change by (1) inundating low-lying regions with low sedimentation rates, such as southern Louisiana and eastern Chesapeake Bay; (2) expanding estuaries and bays, such as Galveston Bay; and (3) raising the base at which storm waves and currents erode coastal landforms and transport sediment. As such, sea-level change plays a critical role, at least on scales of centuries and longer, in determining shoreline position and coastal stability.

The scientific challenge is to isolate and quantify the processes and agents that drive coastal change and to understand the role and importance of feedbacks and thresholds of change. Empirical approaches that monitor morphological change and measure contemporary processes are necessary, but linking cause and effect is difficult, owing to the nonlinear and highly complex behavior of coastal systems. Difficulties in predicting the long-term evolution of the coastal zone are further compounded by the fact that the net morphological change resulting from sea-level rise is typically several orders of magnitude smaller than the gross morphological change resulting from depositional and erosional events acting over days, months, and years.

The geologic record shows that global sea level has risen more than 100 m since the end of the latest glacial maximum about 20,000 years ago. Although the overall picture is generally understood, important details on the rate and timing of marine transgressions, regressions, and stillstands are largely unknown. Analyses of tide-gauge records show that global sea level has risen 20 to 30 cm during the past century. Tide-gauge records around the United States show significant variations in relative sea-level rise: 2.2 mm/yr for Key West, FL, 3.1 mm/yr for Baltimore, MD, 10 mm/yr for Grand Isle, LA, and 1.5 mm/yr for San Francisco, CA. This regional variation is due to geologic subsidence or uplift superimposed on global sea-level rise. A report released in 2001 by the Intergovernmental Panel on Climate Change (IPCC) projects that global sea level will rise 48 cm by 2100, which is about double the rate of the past century. Thus, sea-level change has the potential to be a major factor for society in planning to manage and protect coastal resources for the future. However, our scientific understanding of recent sea-level history and the relationships between sea-level change and coastal evolution is grossly incomplete. An improved understanding of sea-level history and how the coasts have evolved during the recent past (the past 10,000 years) is likely to be our most reliable means of predicting the future effects of sea-level change on coastal systems. A longer-term view is provided by the geologic record, which spans millions of years; it records the net result of coastal processes operating over long time periods and thus the systematic, rather than short-term, components of coastal evolution. Placing recent and predicted sea-level trends within a longer-term geologic context is critical to improve our scientific understanding of the links between climate change, sea-level change, coastal erosion and accretion, and changes in wetland and coral-reef ecosystems.

(Sea-Level Change continued from page 10

change, which are summarized in the box accompanying this article, entitled "The Need for Better Scientific Understanding of Sea-Level Change."

Presentations at the meeting encompassed a range of topics, including

- modeling coastal-wetland responses to storms and sediment inputs,
- mapping paleoshoreline features on the mid-Atlantic shelf,
- assessing coastal vulnerability to sea-level change,
- geologic evidence for higher-than-present sea levels in Hawaii and the equatorial Pacific Ocean,
- effects of subsidence on the sinking of New Orleans,
- using geographic information systems (GIS) to visualize Washington State coastal evolution,
- modeling regional coastal-system response to sea level, and
- short-term sea-level response to Pacific coast El Niño events.

An afternoon field trip on September 24 gave attendees the opportunity to learn about the glacial origins of Cape Cod; to visit six sites along the coast, including Woods Hole, Chatham/Nauset Beach, Sandy Neck/Barnstable marsh, and Sandwich Beach; and to witness the effects of sea-level change and the complex coastal processes that have formed present-day Cape Cod.

Results of the workshop are being synthesized, and a plan for future sea-level-change research will be forthcoming. The plan will contain justifications and recommendations for enhanced USGS-supported research aimed at better understanding sea-level change and predicting the likely effects on coastal systems. Integral to the plan will be interdisciplinary studies involving teams of scientists from the USGS, universities, and other Federal science agencies, such as the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA).

A principal research topic anticipated to be in the plan is the development of predictive models for coastal change as a function of near-future sea-level change. From this effort, we expect that a natural outcome will be plans for national assessments of sea-level-change effects on coastal systems, expressed as probabilities.

The underpinnings of such predictive models will require integration of various complementary research tasks, such as

- comprehensive three-dimensional geologic-framework studies of high-resolution coastal-shelf sedimentary records to decipher late Quaternary sea-level history;
- field studies and a national monitoring program to measure recent and modern sedimentary and biological processes in wetlands and estuaries;
- development of detailed relative-sea-level histories for the past several thousand years in several critical regions, to place recent and future trends in sea-level behavior and coastal response into a geologic context;
- quantification of the rates, magnitudes, and relative roles of the processes driving coastal change, as well as large-scale mechanisms (such as postglacial isostatic adjustment), which serve both as sources of uncertainty in past sea-level history and as vital components of modern global sea-level-change determinations; and
- field studies and modeling of the geologic controls on coastal aquifers and potential for saltwater intrusion.

Remote-Sensing Curriculum for Evaluating Change at Cape Cod National Seashore

By VeeAnn Cross and Chris Polloni

Beth Schwarzman, liaison to schools for the U.S. Geological Survey (USGS)'s Woods Hole Field Center (WHFC), suggested that **VeeAnn Cross** and **Chris Polloni** might represent the USGS on a remote-sensing project between the National Park Service's Cape Cod National Seashore (CCNS) and the National Aeronautics and Space Administration (NASA). The project goal is to develop high-school-level curriculum material in which remotely sensed data are used to evaluate change in Cape Cod's coastal ecosystems and to determine how this change relates to global issues (see NASA's Teaching Earth Science Web site at URL **http://earth.nasa.gov/education/**). The CCNS is looking for partners to participate through the 2-year grant period that has been established.

__Nancy Finley__, naturalist at the CCNS, providing an overview of the remote-sensing-curriculum project to meeting participants. __VeeAnn Cross__ (USGS) is seated on the far right. __Anne Smrcina__, outreach coordinator for the National Oceanic and Atmospheric Administration (NOAA)'s Stellwagen Bank National Marine Sanctuary, is across the table from __VeeAnn__. Photograph by __Barbara Dougan__, National Park Service.

One of the first steps was to have a group of remote-sensing specialists and users meet with CCNS representatives to help them establish the focus-and-development stage of the project. **VeeAnn** and **Chris** attended this meeting on Thursday, September 26, at Cape Cod National Seashore's headquarters building in South Wellfleet, MA. They traveled to the meet-

(Cape Cod continued on page 12)

(Cape Cod continued from page 11)

ing with **Tom Stone** (Woods Hole Research Center remote-sensing specialist) and **Kate Madin** (Woods Hole Oceanographic Institution curriculum specialist) and joined 16 other invited attendees.

The following week, CCNS brought in 20 teachers to provide ideas and suggestions for developing school curriculums. At this stage, the level of USGS involvement is unclear. The WHFC's activity may be limited to an advisory role in the focus-and-development stage. **Barbara Dougan**, education coordinator, and **Nancy Finle**y, naturalist, both from CCNS, organized and moderated the meeting and are the CCNS contacts for further information. **Nancy** announced that the contracts for the pending construction of the Atlantic Learning Center had been awarded. These contracts are for (1) designing the restoration of two buildings at the former North Truro Air Force Station on Cape Cod, (2) interior demolition, (3) a wet/dry laboratory for visiting researchers, and (4) an educational classroom facility.

Heads-Up for Familiar Faces at Fall Meetings

By John Bratton

Scientists of the U.S. Geological Survey (USGS)'s Coastal and Marine Geology Program (CMGP) will be out in force at two of the largest annual meetings of Earth scientists (combined attendance of more than 15,500): the Geological Society of America (GSA) meeting in Denver (Oct. 27-30) and the American Geophysical Union (AGU) meeting in San Francisco (Dec. 6-10). CMGP authors contributed at least 17 abstracts for the GSA meeting and 33 abstracts for AGU. **Wylie Poag** presided at a GSA session titled "Chesapeake Bay Impact Structure: Geology, Geophysics, and Geohydrology of America's Largest Crater." An AGU session titled "Coastal Geology of the Carolinas: Linking the Shelf and Shore" has been convened by **Bill Schwab** and **Rob Thieler**, among others. Other exciting topics covered by CMGP scientists at the meetings include Mississippi Delta history, Big Sur landslides, foram hitchhikers, the Puerto Rico Trench, the Great Blue Hole in Belize, Gulf of Mexico gas hydrates, ocean-circulation and sediment-transport models, carbon dioxide sequestration, estuary sedimentation, paleoseacliffs, tsunami models, metals in corals, and submarine avalanches. Check the lists of "Publications Submitted for Director's Approval" in the September and October issues of *Sound Waves* for information on most AGU abstracts, and the August and September issues for GSA abstracts.

Informal Talks at the Woods Hole Field Center Give Interns a View of the Career Paths of Local Scientists

By Erika Hammar-Klose

For the past 2 years, **Erika Hammar-Klose** and **Ellen Mecray** of the U.S. Geological Survey (USGS)'s Woods Hole Field Center (WHFC) have organized a series of informal chats with scientists from the WHFC and the Woods Hole Scientific Community. These talks, informally titled "How I Got to Where I Am Today," are designed to give the WHFC interns a glimpse into the career paths of local scientists. The sessions include an informal talk by the speaker about his or her education and career path, followed by some advice. After the talk, the session is opened for questions and discussion.

The feedback has been very positive from both scientists and interns. The scientists have found giving the talks to be a rewarding experience. The interns enjoy learning about other paths and contemplating how to apply other experiences to their own futures. This fall's series of informal talks is aimed at bringing in the community outside the USGS, as well as highlighting the technical staff within the WHFC. Our schedule is as follows:

Oct 2: **Peter Schlesinger**, geographic-information-systems (GIS) technician at Woods Hole Research Center

Oct. 16: **Tracy Hampton**, National Public Radio (NPR) science reporter

Oct. 30: **Martha Tarafa**, Associate Director of Development at Woods Hole Research Center

Nov. 13: **Tommy O'Brien** and technical staff of the WHFC

Dec. 4: **Neal Scott**, researcher at Woods Hole Research Center

Dec. 18: **Skee Houghton**, ecologist at Woods Hole Research Center

Staff and Center News

Visiting Delft Engineer Brings Modeling Expertise to USGS

By Guy Gelfenbaum

Giles Lesser has recently joined the U.S. Geological Survey (USGS)'s Coastal and Marine Geology Program as a visiting scientist to work with **Guy Gelfenbaum** and **Chris Sherwood** on sediment-transport and morphological modeling. Stationed in Menlo Park, CA, **Giles** is visiting from Delft Hydraulics in the Netherlands, where he works as a researcher and advisor in Delft Hydraulics' Marine and Coastal Infrastructure section. **Giles** will work

(Visiting Scientist continued on page 13)

(Visiting Scientist continued from page 12)

with **Guy**, **Jessica Lacy**, **Peter Ruggiero**, and **Laura Kerr** as they model estuarine sediment transport and morphological change in Willapa Bay, WA, to help the U.S. Army Corps of Engineers and the Shoalwater Bay Tribe address severe erosion of tribal lands. **Giles** will work with **Chris**, **Jessie**, and **John Warner** to model Grays Harbor, WA, and to help develop test cases for comparison and evaluation of sediment-transport models as part of the Community Sediment Transport Project.

Giles' experience with Delft Hydraulics has covered a range of coastal-engineering applications, from wave-penetration and ship-motion studies to the application and further development of Delft's numerical morphological models. Before going to study in Delft, **Giles** worked for several years as a civil engineer for a local authority in his home country, New Zealand. **Giles** has a Bachelor of Engineering degree from the University of Canterbury in Christchurch, New Zealand, and a Master of Science degree in coastal engineering from the International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE) in Delft, the Netherlands. Since completing his thesis on the inclusion of sediment transport in the Delft3D hydrodynamic model, **Giles'** morphological modeling experience has included developing several physical morphological models, addressing harbour-siltation problems, and modeling morphological changes around manmade structures.

*Visiting scientist **Giles Lesser** examining the beaches of Washington State.*

Tom Parsons Succeeds Homa Lee as Acting Chief Scientist for the Western Region Coastal and Marine Geology Team

In early October, **Tom Parsons** became the Acting Chief Scientist for the Coastal and Marine Geology team in Menlo Park, CA. **Tom** took over from **Homa Lee**, who had held the post since last January. The change was announced in an e-mail message from Acting Western Regional Geologist **Mike Carr**, quoted in part below:

> It gives me great pleasure to announce that **Tom Parsons** has agreed to serve as acting Chief Scientist for the Coastal and Marine Geology team for four months, effective on or about October 6, 2002, until the end of January 2003.
>
> **Tom** joined the USGS in 1992 as a National Research Council Post-Doctoral Fellow. He is a research geophysicist who studies seismotectonics and seismic hazards of California and the Pacific Northwest. He uses modeling techniques to simulate the Earth's response to sudden stress changes caused by magmatic intrusions or earthquakes, and to learn how those changes may inhibit or increase fault slip. He uses sound waves to measure the Earth's structure in active tectonic regions, and applies this information to relate the motion of tectonic plates to slip on individual faults. **Tom** served as project chief of the Central California Earthquake Hazards project, which included leadership of a complex, multiship seismic experiment. He also played a leadership role in the Seismic Hazards in Puget Sound (SHIPS) experiments. **Tom** is on the editorial board for *Geology* and has served on the Coastal and Marine Geology Program Council. Currently, he has a leadership role in writing the 5-year plan for the Coastal and Marine Geology Program.
>
> Please join me in welcoming **Tom Parsons** to the management team in Western Region. We appreciate his willingness to use his many scientific and leadership skills in continuing the outstanding scientific work of the Coastal and Marine Geology team.
>
> At the same time, join me in thanking **Homa Lee** for the excellent leadership that he has provided to the Coastal and Marine Geology team over the past 9 months. Also join me in again thanking **Terry Bruns**, who always is there for the team as Associate Chief Scientist. We are indeed fortunate to have leaders such as **Homa**, **Terry**, and **Tom**, who will set aside their own goals and convenience to lead us through times of change.

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